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# NASA TECH BRIEF

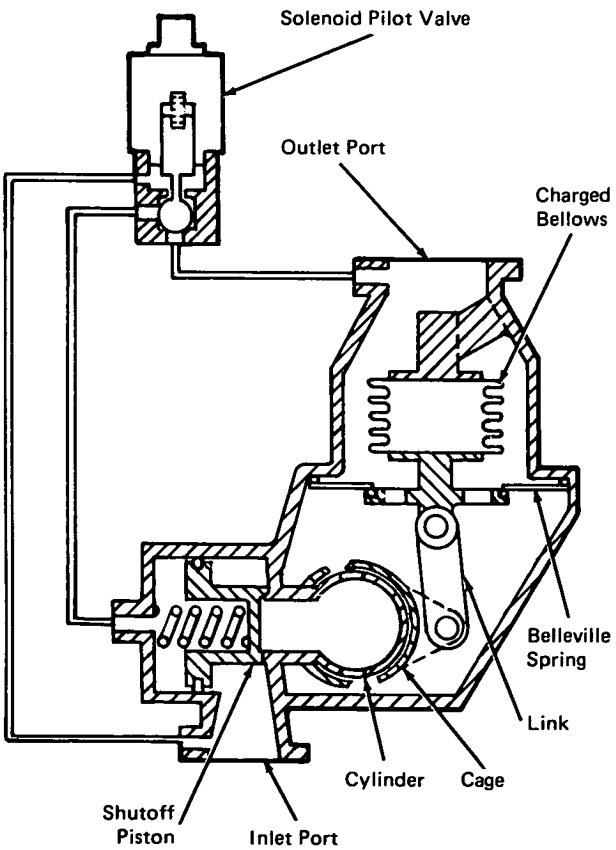
*Lyndon B. Johnson Space Center*



## Mass Flow Controller for Gaseous Propellants

### The problem:

Constant output levels in internal combustion and rocket engines are maintained by precise control of fuel delivery. This precision is particularly important in rocket engines designed for constant thrust levels. Control of the mass flow rate of fuel is especially difficult to maintain when gaseous propellants are used. In comparison with liquid fuels, gaseous propellants exhibit large variations in pressure and temperature and hence in fuel delivery.




### The solution:

An all-mechanical, mass flow controller that will compensate for these variations has been developed to maintain a constant fuel flow rate of gas.

### How it's done:

The schematic drawing of the mass flow controller is shown in the figure. The controller incorporates a shutoff poppet which is controlled by a two-position, three-way, solenoid pilot valve for the on-off function. Downstream of the shutoff poppet is the pressure-balanced throttling element consisting of a stationary cylinder and a rotating cage. The cage is normally positioned by the Belleville spring so that its slots are aligned with the slots in the cylinder. When the pressure, $P_o$, at the outlet rises to the set value, the bellows which connects with the cage through a linkage rotates the cage toward a more restrictive position. The amount of cage rotation is that required to maintain the outlet pressure at its correct value for the temperature of the propellant. When the propellant temperature increases, the internal pressure in the bellows increases and causes the controller to increase the outlet pressure to a higher value.

Based on analytical computations, the controller is designed to maintain outlet pressure to within ± 1% over the entire temperature range of 116 to 311 K (-250° to 100° F), provided the inlet pressure range is limited to $3.6 \times 10^6$ to $4.9 \times 10^6$ N/m$^2$ (500 to 700 psig).

### Notes:

1. The ± 1% tolerance is still subject to dynamic verification. Further work is necessary to ease the inlet pressure limitation.

(continued overleaf)

2. The following documentation may be obtained from:
National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference: NASA CR-128639 (N73-12860), Development Report, Mass Flow Controller

**Patent status:**

NASA has decided not to apply for a patent.

Source: Systems Division of
Parker Hannifin Corp.
under contract to
Johnson Space Center
(MSC-14221)